

EFFECT OF THERMAL TREATMENT ON THE BIOACTIVE COMPOUNDS IN GREEN CHILLI POWDER

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ABSTRACT

The effects of drying methods, such as sun drying at 30- 42 °C, tray drying at 60 °C and lyophilizer drying, on the quality of dried two local varieties of green chilli in India (Pusa Jwara and Jalapeno M) were investigated. It used for drying method for getting powder after that the bioactive compound were determined. The result showed that the bio-active compound were found higher in variety Pusa Jwara than Jalapeno M, also the result showed that the lyophilizer drying method was the best followed by tray drying and sun drying. There were significantly different among the varieties also among drying methods ($P>0.05$). The unique colour attributes in the lyophilizer drying, tray drying, and sun drying samples were green.

KEYWORDS: Green Chilli, Green Chilli Powder, Bioactive Compounds, Drying Methods

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INTRODUCTION

The term 'spices' is often used to cover a wide variety of dried or natural aromatic plant products that are used in building the flavors and sometimes making food acceptable, palatable and digestible. True spices are defined as parts of aromatic plants, such as bark, root, buds, flowers, fruits, and seeds that are grown in the tropics. Examples of spices include allspice, aniseed, caraway, turmeric, coriander, onion, garlic and chilli etc (Peter, 2001).

Chilli (*Capsicum spp*) belongs to the family of *Solanaceae*, widely used as spices, native of Central America and the West Indies. It is a favorite spice in the Indian subcontinent. Chilli is one of the most popular spices in the world. It is very frequently used as raw green, ripe and dried form either as paste or powder forms. Dry chillies are extensively used as a spice in all types of mostly curried dishes in the tropical and sub-tropical countries (Rahman, *et al.*, 1978).

There are many types of dryer used in the domestic and industry sectors. The commonly used dryer are tray dryers, tunnel dryers, drum dryers, fluidized bed drying, spray dryers, flash dryers, rotary dryers, belt dryers, vacuum dryers and lyophilizer dryers. Currently, hot air drying (HD) is more popularly used for drying chilli due to a relatively short time of drying and also due to uniform heating and more hygienic characteristics. The temperature ranges from 45 °C to 70 °C (10% of moisture content, approximately), and this will reduces

drying time to less than 20 hrs. This temperature range of hot air drying gives maximum color values and minimizes the loss of volatile oils and discoloration (Mínguez-Mosquera *et al.*, 2003). Polyethylene packaging material was used in powder packaging.

Literature on usages of chilli and its products is limited. The delicate aroma, color and pungency of fresh chilli cannot be compared with dried chilli. Thus there is potential to explore the technology for processing of chilli which can retain delicate fresh flavour. By applying the proper technology for processing of chilli (*Capsicum spp*), a significant amount of chilli can be saved from wastage and the availability of chilli can be ensured in the off season. It can also help the farmers to get good price that will help to increased yield and production. The aim of this study was to carry out effect of Thermal Treatment on the bioactive compounds in Green Chilli powder.

MATERIALS AND METHODS

Sample Collection

Samples was procure from the local market in Varanasi city in U.P. India and the analysis was done in lab of center of food science and Technology, BHU Varanasi, India.

Physical Analysis

Weight, Volume, Length, Waste and Waste index were done manually. Surface color measurement was conducted using the $L^* a^* b^{*1}$ (Universal Hunter Lab, Model 45/0 S/N CX- 0413). Absorbance at 540 nm was determined According to (Take Ajay Kumar *et al.*, 2012) with some modification, 0.5 gram extract with 5 ml of ethanol after that filtration with filter paper after that measure the Absorbance at 540 nm in spectrophotometer.

Chemical Analysis

The proximate analysis for the fresh and dried green chillies (two varieties) was done by determine the moisture, fat, ash and fat contents as per method recommended by the Association of Official Analytical Chemists (AOAC) and Ranganna (1986). The percentage of protein present in the samples was determined by the Micro-kjeldhalmethod (Esayas, 2011).

Ascorbic acid was analyzed using the 2,6-dichlorophenol indophenol titrimetric method (AOAC, 1990). Total phenolic compounds were determined using the Folin-Ciocalteu reagent and gallic acid as a standard (Spanos and Wrolstad, 1990). Reducing sugar was analyzed using the Nelson-Somogyi method (Ranganna, 1986), which is suitable for food with low reducing sugar. The concentration of reducing sugar was obtained using a spectrophotometer at 520 nm and a standard curve of glucose was used.

¹ L^* lightness, a^* greenness and b^* yellowness

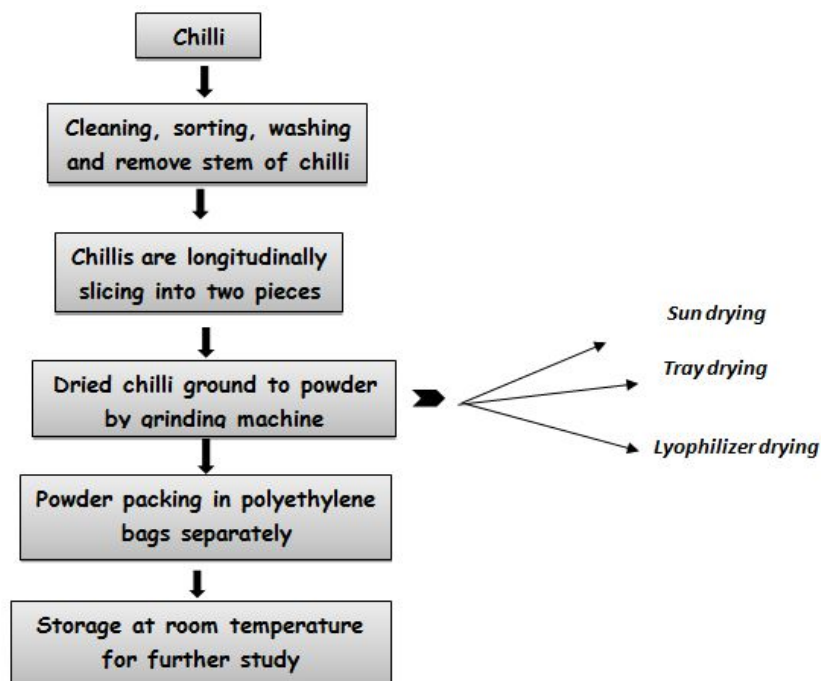


Figure 1: Flow Diagram for Development of Green Chilli Powder

Determination of Capsaicin Content

Ten grams of ground sample was placed in a 250 ml flask with 100 ml of acetone. The sample was stirred for 1 hour at room temperature. It was filtered by vacuum and the volume of the supernatant was reduced to approximately 5 ml by removing the excess acetone using nitrogen gas. The final solution was filtered through a 0.45 mm filter before injection to high performance liquid chromatography (HPLC). Ten microliters of extracted sample was injected for analysis by HPLC equipped with a Luna C18 column (5 μ , 250 \times 4.6 cm) and a UV detector at 284 nm. The mobile phase used a mixture of methanol and water (80:20 v/v) and a flow rate of 1.5 ml/min (Betts, 1999). The capsaicin in each sample was quantified by comparing it with capsaicin standard compounds (from Sigma, USA). A standard curve was prepared using serial dilutions of 0.15, 0.63, 1.25, 5.00, 10.00 and 20.00 mg/100 gm. capsaicin concentrations.

Statistical Analysis

All the means of the triplicate values and standard deviations from the obtained data were calculated and statistically analyzed using SAS version 9.1. Meanwhile, Duncan's multiple range tests was employed to determine the differences in the different compositions among the samples.

RESULT AND DISCUSSIONS

Physical Parameter of Green Chilli

The length, average weight, waste index, colour and volume of raw green chilli of both varieties was determined and values are represented in table 1

Table 1: Physical Analysis of Raw Green Chilli

Measurement		Varieties	
		<i>Pusa Jwara</i>	<i>Jalapeno M</i>
Weight of 5 pieces (gm)		21.73	17.84
Waste (gm)		0.88	0.83
Waste index (%)		4.05	4.67
Volume (ml)		8.59	7.19
Length(cm)		9.63	2.93
Color		Dark Green	Pale Green
	L	37.04	46.98
	a	-9.46	-0.36
	b	18.69	19.52

Composition of Raw Green Chilli

The Raw green chilli was analyzed for moisture, protein, fat, ash and vitamin C and these results are presented in Table 2. The fresh green chilli *Pusa Jwara* variety contained 87.37% moisture, 5.83 % protein, 1.77 % fat, 0.824 % Ash, 112.27 mg per % of vitamin C. Fiber 3.2667%, Reducing sugar 6.15% and capsicum 0.03867 mg/100 gm. Also in the second variety *Jalapeno M* contained 85.69% moisture, 4.77% protein, 1.10 % fat, 1.08 % Ash, 106.20 mg per % of vitamin C. Fiber 2.53%, reducing sugar 5.22% and capsicum 0.03433mg/100gm.

The results reported by Srivestava *et al.*, (1994) were similar to the proximate chemical composition of fresh green chilli contained 85.5 % moisture, 5.4 % protein, 1.1 % fat, 1.2 % mineral, 110 mg per % of vitamin C. The small variation may be due to varietal difference, soil property, growing condition, harvesting period, maturity stage, agro-ecological condition and methods of analysis.

Table 2: Chemical Analysis of Raw Green Chilli

Compounds	Varieties	
	<i>Pusa Jwara</i> M± SD*	<i>Jalapeno M</i> M± SD*
Moisture content (%)	85.69±0.738 ^a	87.37±1.092 ^a
Ash (%)	0.824±0.123 ^a	1.08±0.123 ^a
Fat (%)	1.77±0.0153 ^a	1.10±0.0200 ^b
Protein (%)	5.83±0.208 ^a	4.77±0.152 ^b
Ascorbic acid mg/100g	112.27±0.351 ^a	106.20±0.265 ^b
Fiber (%)	3.27±0.116 ^a	2.53±0.153 ^b
Reducing sugar (g) /100g	6.15±0.327 ^a	5.22±0.214 ^b
Capsaicin (mg/100gm)	0.037±0.002 ^a	0.034±0.004 ^a

*Mean ± Standard deviations (n = 3).

Means in the same column with different lower-case letters are significantly different ($P < 0.05$).

Effect of Drying Method on the Color in Green Chilli Powder

The effect of different drying methods on the colour qualities of chilli is shown in table 3. It was shown that the L* values of all dried chilli ranged from 40.23 to 50.68. The a* values ranged from -8.01 to -1.67 and the b* values ranged from 0.88 to 8.74. Compared with the fresh chilli (L* = 37.04, a* = -9.46 and b* 18.69) in the variety *Pusa Jwara*, but in the *Jalapeno M* variety was the L* values of all dried chilli ranged from 45.45 to 59.45. The a* values ranged from -1.03 to -0.86 and the b* values ranged from 3.87 to 12.34. Compared with the fresh chilli (L* = 46.98, a* = -0.36 and b* 19.52). This result showed that the Lyophilizer Drying method significantly improved the greenness of dried chilli compared to the other drying methods. This can be explained by the low temperature within a product due to the poor internal heat transfer in the dry layer of a product during the Lyophilizer Drying method.

Table 3: Effect of Drying Method on the Color in Green Chilli Powder

Treatment		Varieties	
		<i>Pusa Jwara</i>	<i>Jalapeno M</i>
Lyophilizer Drying	L	40.23	45.45
	a	-8.01	-1.03
	b	0.88	3.87
Tray Drying	L	45.05	54.65
	a	-4.30	0.23
	b	3.19	6.34
Sun Drying	L	50.68	59.45
	a	-1.67	-0.86
	b	8.74	12.34

Effect of Drying Method on the Vitamin C in Green Chilli Powder

The vitamin C content of the samples lyophilizer dryer, tray dryer sun dryer powders were ranged from 90.7 to 165.2 mg/100 gm. in variety (*Pusa Jwara*) and from 70.6 to 156.3 mg/100 gm in variety (*Jalapeno M*), both being lowest for sample (sun dryer) and the highest for sample (lyophilizer dryer) contained higher vitamin C (Table. 4). The result also showed the amount of vitamin C is high in variety *Pusa Jwara* than *Jalapeno M* also there is significant effect due to varieties.

The results were more or less similar to those reported by Leung et al.(1972) who noticed that, vitamin C was 184 mg/100 gm. in dry chilli per 100 gm. Ahmed et al.(1986) analyzed the ascorbic acid content in 12 different chilli genotypes and reported that it increased from green stage (98-1616 mg/100 gm.) to ripe stage (905-2254 mg/100 gm.) and further at sun drying stage (240-4550 mg/100 gm.). The ascorbic acid content of chilli powder increased significantly with maturity stage.

Table 4: Effect of Drying Method on the Vitamin C in Green Chilli Powder

Treatment	Varieties	
	<i>Pusa Jwara</i> M ± SD*	<i>Jalapeno M</i> M ± SD*
Raw Green Chilli	a 112.3 ± 0.351 ^a	a 106.2 ± 0.265 ^b
Lyophilizer Drying	b 165.2 ± 0.200 ^a	b 156.3 ± 0.400 ^b
Tray Drying	c 130.5 ± 0.100 ^a	c 111.8 ± 0.600 ^b
Sun Drying	d 90.7 ± 0.300 ^a	d 70.6 ± 0.493 ^b

*Mean ± Standard Deviations (n = 3).

The same letter in front number that means there is no significant between treatments ($P < 0.05$).

The same letter behind number that means there is no significant between varieties ($P < 0.05$).

Total Phenol Content in Green Chilli Powder

The Total Phenol Content of the samples lyophilizer dryer, tray dryer and sun dryer powders were lowest for sample (sun dryer) and the highest for sample (lyophilizer dryer) contained higher vitamin C (Table 5). The result also showed the amount of Total Phenol Content is high in variety *Pusa Jwara* than *Jalapeno M* also there is significant effect due to varieties, The samples were ranged from 120.56 to 165.40 mg/100 gm. in variety (*Pusa Jwara*) and from 113.07 to 156.03 mg/100 gm. in variety (*Jalapeno M*).

Table 5: Effect of Drying Method on the Total Phenol Content in Green Chilli Powder

Treatment	Varieties	
	<i>Pusa Jwara</i> M± SD*	<i>Jalapeno M</i> M± SD*
Raw Green Chilli	a 13.30±0.515 ^a	a 10.25±0.496 ^b
Lyophilizer Drying	b 165.40±0.210 ^a	b 156.03±0.746 ^b
Tray Drying	c 154.14±0.544 ^a	c 146.54±0.963 ^b
Sun Drying	d 120.56±0.949 ^a	d 113.07±0.496 ^b

*Mean ± Standard Deviations (n = 3).

The same letter in front number that means there is no significant between treatments ($P < 0.05$).

The same letter behind number that means there is no significant between varieties ($P < 0.05$).

Antioxidant Activity of Green Chilli Powder

The antioxidant activity (Table 6) was determine by using inhibitor color of free radical compound (DPPH) the result showed that the sample from lyophilizer dryer got highest inhibition than others also The result showed the amount of antioxidant activity is high in variety *Pusa Jwara* than *Jalapeno M*.

Table 6: Effect of Drying Method on the DPPH Inhibition in Green Chilli Powder

Treatment	Varieties	
	<i>Pusa Jwara</i> M± SD*	<i>Jalapeno M</i> M± SD*
Raw Green Chilli	a 85.51±0.818 ^a	a 85.96±0.661 ^a
Lyophilizer Drying	b 19.09±0.259 ^a	b 22.22±0.708 ^b
Tray Drying	c 23.21±0.644 ^a	c 24.99±0.763 ^b
Sun Drying	d 26.68±0.124 ^a	d 28.69±0.753 ^b

*Mean ± Standard Deviations (n = 3).

The same letter in front number that means there is no significant between treatments ($P < 0.05$).

The same letter behind number that means there is no significant between varieties ($P < 0.05$).

Effect of Drying on Capsaicin Content

From table 7, it can be seen that all drying methods have affect the capsaicin content. The capsaicin content of dried chilli from all the drying methods was higher than in the fresh chilli sample ($P \leq 0.05$). The lower capsaicin content in fresh chilli may due to the peroxidase enzyme by catalytic activity.

Table 7: Effect of Drying Method on the Capsaicin Contents (mg/100 gm) in Green Chilli Powder

Treatment	Varieties	
	<i>Pusa Jwara</i> Mean± SD*	<i>Jalapeno M</i> Mean± SD*
Raw Green Chilli	_a 0.039±0.0015 ^a	_a 0.034±0.0040 ^a
Lyophilizer Drying	_b 0.135±0.0050 ^a	_b 0.130±0.0051 ^a
Tray Drying	_c 0.100±0.0100 ^a	_c 0.091±0.0070 ^a
Sun Drying	_d 0.078±0.0027 ^a	_d 0.069±0.0077 ^a

*Mean ± Standard Deviations (n = 3).

The same letter in front number that means there is no significant between treatments ($P < 0.05$).

The same letter behind number that means there is no significant between varieties ($P < 0.05$).

CONCLUSIONS

The Lyophilizer Drying samples gave highest ascorbic acid content, total phenol count, and antioxidant activity than Tray Drying and Sun Drying samples. The lyophilizer drying, tray drying, and sun drying methods affected on the capsaicin concentration in all the dried green chilli. The bio-active compounds were found higher in variety *Pusa Jwara* than *Jalapeno M*.

The study has demonstrated exclusively that green chilli powders of both the varieties *Pusa Jwara* than *Jalapeno M* obtained by lyophilizer drying method gave the best results rather other processing methods because in other methods like sun drying, tray and drying the color and bioactive compounds content lost during the processing. This green chilli powder, people can be used whole year.

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